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Artikel Asli/*Original Article*

Association between Tooth Loss and Body Mass Index Among Older Adults in Kuala Pilah, Negeri Sembilan

(Perkaitan antara Kehilangan Gigi dan Indeks Jisim Tubuh dalam Kalangan Warga Tua di Kuala Pilah, Negeri Sembilan)

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ABSTRACT

Loss of teeth can affect masticatory efficiency in older adults. This may result in avoidance or modifications in food choices and lead to lower intake of important nutrients among older individuals. The aim of this study was to determine the association between tooth loss and body mass index, BMI, among older adults in Kuala Pilah, Negeri Sembilan. A cross-sectional study was carried out on 428 older adults aged 50 years and above from selected villages in district of Kuala Pilah. Respondents were interviewed to collect information on their demographic characteristics. Number of tooth loss was determined through oral assessment, followed by anthropometric assessment to calculate the BMI of respondents. Findings showed that majority of the respondents were overweight and obese, 40.4% and 19.9% respectively, while only a small proportion was underweight, 3.9%. The proportion of edentulism (total tooth loss) was 18.3% and majority of the older adults had lost more than 12 teeth (77.1%) and less than 4 pairs of occluding posterior teeth (86.0%). Total and partial tooth loss was found to be not significantly associated with BMI. In relation to the arrangement of teeth, older adults with reduced number of posterior occluding pairs of teeth were more likely to experience unsatisfactory BMI (OR = 3.61, 95% CI: 1.48, 8.76). This may suggest that functional arrangement of the tooth in the oral cavity is more important than the number of tooth loss alone. Thus, maintaining an optimum number of teeth for chewing is essential for maintenance of ideal BMI.

Keywords: Body mass index; cross-sectional study; elderly; oral health; tooth loss

ABSTRAK

Kehilangan gigi boleh mempengaruhi keberkesanan pengunyahan di kalangan warga tua. Keadaan ini boleh mengakibatkan warga tua mengelak atau mengubah suai pilihan makanan mereka, dan membawa kepada kurangnya pengambilan nutrien penting. Tujuan kajian ini adalah untuk menentukan perkaitan antara kehilangan gigi dan indeks jisim tubuh di kalangan warga tua di Kuala Pilah Negeri Sembilan. Satu kajian hirisan lintang telah dijalankan di kalangan 428 orang warga tua berumur 50 tahun ke atas daripada beberapa kampung terpilih di daerah Kuala Pilah. Responden ditemu bual untuk mendapatkan maklumat berkaitan ciri demografik dan status kesihatan. Jumlah kehilangan gigi ditentukan melalui pemeriksaan mulut, diikuti dengan pengukuran antropometri untuk mengira indeks jisim tubuh. Hasil kajian menunjukkan majoriti daripada responden masing-masing mempunyai berat badan berlebihan dan obes, 40.4% dan 19.9%, sementara hanya peratusan kecil (3.9%) yang mempunyai kurang berat badan. Peratusan warga tua yang kehilangan kesemua gigi adalah 18.3% dan lebih daripada tiga per empat (77.1%) telah kehilangan lebih daripada 12 batang gigi, serta 86% mempunyai kurang daripada 4 pasangan gigi posterior yang beroklud. Kehilangan kesemua atau sebahagian daripada jumlah gigi didapati tidak berkait secara signifikan dengan indeks jisim tubuh. Apabila susunan gigi diambil kira, warga tua yang mempunyai kurang daripada 4 pasangan gigi posterior yang beroklud didapati lebih berkemungkinan mempunyai indeks jisim tubuh yang tidak memuaskan (OR = 3.61, 95% CI: 1.48, 8.76). Kesimpulannya, dicadangkan bahawa susunan fungsian gigi di dalam kaviti mulut adalah lebih penting daripada hanya bilangan gigi. Justeru, adalah penting untuk mengekalkan bilangan gigi yang optimum untuk tujuan pengunyahan agar dapat mengekalkan indeks jisim tubuh yang sihat di kalangan warga tua.

Kata kunci: Indeks jisim tubuh; kajian hirisan lintang; kesihatan mulut; kehilangan gigi; warga emas

INTRODUCTION

Older adults are faced with several oral health problems. Dental caries, periodontal disease and partial and total tooth loss are prevalent in this group (Ramsay et al. 2015). In Malaysia, similar conditions were observed whereby data from the National Oral Health Survey of Adults (NOHSA) in 2010 showed poor oral health status among the older

population as compared to the younger age group. Among elderly aged 60 years and above, about 36.8% were edentulous while the mean number of remaining teeth was 9.8. High prevalence of coronal caries and periodontal disease were also noted among the group (Ministry of Health 2013).

As the prevalence of tooth loss is high among older people, chewing ability may be reduced leading to inadequate intake of important nutrients. The association between tooth loss and nutritional status has been researched in many studies (Peruchi et al. 2016; Singh et al. 2015). Reduction in number of functioning teeth may lead to food avoidance and difficulties in chewing (Tada & Miura 2014), poor diet quality (Gomes et al. 2016), less intake of specific nutrients (Koodaryan et al. 2014), inadequate calorie intake (Zhu & Hollis 2014), underweight (Hu et al. 2015) and overweight or obese (Nascimento et al. 2016) among the aged population.

Earlier studies have indicated that a complete dentition is not necessary for oral functional needs. Adults with at least 20 natural teeth is said to have sufficient oral function. A systematic review by Gotfredsen and Walls (2007) to evaluate the relationship between dentition and oral function has also confirmed that a dentition consisting of 20 teeth would assure an acceptable level of oral function (Gotfredsen & Walls 2007).

However, with limited emphasized and knowledge towards research on the link between oral health and nutritional conditions among older adults in Malaysia, this study aimed to assess the association between tooth loss and nutritional status among a group of older adults in Negeri Sembilan.

METHODS

This cross-sectional study was conducted in two sub-districts of Kuala Pilah, Negeri Sembilan, namely Pilah and Johol. Kuala Pilah consists of 11 sub-districts. Sub-districts Pilah and Johol were chosen as they have the highest percentage of older adults more than 50 years of age among other sub-districts in Kuala Pilah (Department of Statistics, Malaysia 2011). Both sub-districts have similar socio-economic background as well as the number of older adults residing in the areas. Twenty villages were randomly selected from the sub-districts. Consecutive sampling method was applied in this study whereby all the older adults within the selected villages who attended the oral health screening were consecutively selected.

Malaysian older adults aged 50 years and above, had been living in the selected areas for at least one year and could communicate clearly in Bahasa Malaysia were included in this study. Those who were mentally ill and with other conditions that could affect the history taking and anthropometric measurements were excluded. The cut-off point of 50 years and above for the age group was adapted from the WHO study on Global AGEing and Adult Health (SAGE) in six lower-and upper-middle income countries (China, Ghana, Mexico, India, russia and South Africa). Calculation of sample size was based on the formula $n = z^2 \times P(1-P)/d^2$, where n is the sample size, z is the level of confidence at 95%, and P is the estimated prevalence (Fleiss 1981). Based on Suzana et al. 2007 where 51% of the older adults had unsatisfactory BMI, with a power of 80%, 5% precision and 15% non-response rate, an estimated sample size of 442 was required for this study. Approval to conduct the study was obtained from the Medical Research Ethics Committee, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, and all the respondents provided written informed consent.

Data were gathered on socio-demographic characteristics, oral health status and body mass index. Data on socio-demographic were attained from the face-to-face questionnaire interview. Clinical oral examination was carried out to determine the dental conditions of respondents, namely the number of tooth loss (total and partial) and posterior occluding pairs of teeth (POPs). Assessment was based on the oral health examination format for National Oral Health Survey of Adults, 2000 and WHO criteria for Oral Health Surveys, 1997. Only one examiner was involved with dental examination throughout the study and demonstrated high intra-examiner consistency (Kappa value of 0.96). Prior to the study, the examiner was calibrated with an experienced epidemiologist for dental caries and periodontal pocket measurement.

BMI was used to assess the nutritional status of the respondents. Respondents were measured for their standing height and weight, and readings were then used to calculate their BMI [weight (kg)/height (m^2)]. The WHO 2000 classification was used to classify BMI into underweight ($\leq$ 18.4 kg/m^2), normal (18.5-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2) and obese ($\geq$ 30.0 kg/m^2). BMI was further classified into two groups, satisfactory and unsatisfactory. Those who were underweight, overweight and obese were categorized as having unsatisfactory BMI.

Statistical analysis was performed using SPSS version 22.0. Descriptive statistics were determined, such as means and standard deviation (SD) for continuous variables and frequency and percentages for categorical variables. Associations between categorical variables were assessed with the Chi-square test of independence. The significance level was set at $\alpha = 0.05$. A multiple logistic regression was constructed to evaluate the ability of oral health variables to predict unsatisfactory nutritional status among the older adults. BMI (satisfactory and unsatisfactory) was the dependent variable, while age group (50-69/70 & above), self-reported chronic disease (yes/no), dental status (dentate/edentate), total tooth loss (more than 12 teeth/less than 12 teeth) and total posterior occluding pairs of teeth (0-4 pairs/5-8 pairs) were the independent variables included in the model. Confidence interval (CI) at 95% of the odds ratio (OR) and p-value of the association were obtained to make inferences to the study population. Ethical approval was obtained from the Medical Research

Ethics Committee, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia (UPM/FPSK/PADS/T7-MJKEtikaPer/F01(IG_Mei(10)03).

RESULTS

A total of 428 older adults participated in the study with 41.8% were men and 58.2% were women. The mean age was 63.2 years (SD 9.5). Majority (59.1%) of the older people were above 60 years old. From the total respondents, only 4.7% were in the oldest age group (> 80 years old). In relation to formal educational level, 10% had never attended school, 45.3% were with primary and 39% secondary level of education and only a small proportion (5.6%) had tertiary education level. About more than half of the respondents (57.7%) reported that they suffered from at least one chronic disease.

In relation to body mass index, majority of the respondents were overweight and obese, 40% and 19.9% respectively, while only 3.7% were underweight. The mean BMI was 26.3kg/m^2 (SD = 4.6). The demographic characteristics and BMI categories of the older adults were presented in Table 1.

TABLE 1. Socio-demographic characteristics of the study population

Variables		*n*	%	mean	SD
Sex	Male	179	41.8		
	Female	249	58.2		
Age				63.2	9.5
Age Group	50-59	175	40.9		
	60-69	129	30.1		
	70-79	104	24.3		
	80 & above	20	4.7		
Race	Malay	397	89.0		
	Chinese	45	10.1		
	Indian & others	4	0.9		
Marital status	Married	336	92		
	Widowed/Divorced	78.5	21.5		
Education level	No formal education	43	194		
	Primary education	167	24		
	Secondary education	10.0	45.4		
	Tertiary education	39.0	5.6		
Self-reported chronic disease	Yes	247	181		
	No	57.7	42.3		
Smoking status	Ever smoked	62	366		
	Never smoked	14.5	85.5		

Table 2 demonstrates the oral health characteristics of the respondents. About 18.2% of the respondents had lost all their teeth (edentulous). Among dentate elders, almost three-quarter (72.3%) of the respondents had lost more than 12 teeth. As for the posterior teeth that occlude, majority (91.8%) of them had less than 5 pairs of teeth.

Table 3 presents the association between number of teeth with body mass index of the older adults' population. Bivariate analysis using Chi-square test showed no significant different between number of tooth loss, both complete and partial tooth loss, and body mass index of the older adults. However, total number of POPs was found to be significantly different ($p < 0.01$) between respondents with satisfactory and unsatisfactory body mass index.

A multiple logistic regression was constructed to evaluate the ability of number of tooth loss to predict unsatisfactory nutritional status among the older adults. After adjusting for socio-demographic variables, a significant association was found between total number of POPs and BMI. Respondents with reduced number of POPs (0 to 4 pairs of POPs) were more likely to experience unsatisfactory BMI (OR = 3.61, 95% CI: 1.48, 8.76; $p < 0.01$).

DISCUSSION

Tooth loss is one of the main factors to changes in nourishment among older individuals, which later can lead to nutritional disorders like obesity and low body weight. However, in this study no significant association was observed between number of tooth loss and BMI. Lopez-Jornet et al. (2013) highlighted similar findings in both institutionalized and non-institutionalized Spanish elders. The authors revealed that only age and institutionalizations were predictors to malnutrition but not number of teeth

TABLE 2. BMI categories and oral health characteristics of the study population

Oral health characteristics		n	%	mean	SD
Body mass index, BMI	Normal	157	35.8	26.3 kg/m^2	4.6
	Overweight	177	40.4		
	Obese	87	19.93.9		
	Underweight	17			
Dental status	Dentate	350	81.8		
	Edentate	78	18.2		
Total tooth loss	More than 12 teeth	331	77.3		
	Less than 12 teeth	97	22.7		
Total number of posterior occluding pairs of teeth (POPs)	0-4 pairs	393	91.8		
	5-8 pairs	35	8.2		

TABLE 3. Bivariate analysis for the association between number of teeth with satisfactory and unsatisfactory BMI among respondents

Items	Body mass index, BMI (%)		
	Satisfactory	Unsatisfactory	Sig
Dental status			0.154
Edentate	34 (21.8)	44(16.2)	
Dentate	122 (78.2)	228 (83.8)	
Total number of teeth			0.153
0 teeth	34 (21.8)	44 (16.2)	
1-19 teeth	83 (53.2)	170 (62.5)	
20-32 teeth	39 (25.0)	58 (21.3)	
Total number of POPs			0.008*
0-4 pairs	136 (87.2)	257 (94.5)	
5-8 pairs	20 (12.8)	15 (5.5)	

*significant level set at $p < 0.01$

TABLE 4. Multiple logistic regression analysis for the association between unsatisfactory BMI and number of teeth among respondents

Variables	Odd Ratio	95% of CI for OR	p value
Age group			0.022*
50-69	1.69	1.08, 2.64	
70 & above	1.0	-	
Self-reported chronic disease			0.010*
Yes	1.72	1.14, 2.61	
No	1.0	-	
Dentate status			0.210
Dentate	1.0	-	
Edentate	0.71	0.41, 1.21	
Total tooth loss			0.778
More than 12 teeth	1.1	0.59, 2.00	
Less than 12 teeth	1.0	-	
Total number POPs			0.005*
0-4 pairs	3.61	1.48, 8.76	
5-8 pairs	1.0		

*significant level set at $p < 0.05$

(Lopez-Jornet et al. 2013). Earlier studies have also found inadequate evidence to support the association between the number of teeth and impaired nutrients intake among the elderly population (Bradbury et al. 2008; Liedberg et al. 2007).

However, some studies have reported contradicting results. Singh et al (2015) studied 1704 free-living older adults aged 60 and above in southern part of Brazil to clarify the association between dental status and BMI. The results showed elderly with reduced number of teeth were 1.4 times more likely to be centrally obese than individuals with a higher number of teeth (Singh et al. 2015). Further, Peruchi et al. (2016) studied other elderly community in Brazil and indicated that extensive tooth loss increased the likelihood of having central obesity (Peruchi et al. 2016). In contrast, studies conducted among the Asian elderly communities like Sri Lanka (Perera & Ekanayake 2012) and Indonesia (Adiatman et al. 2013) also concluded that tooth loss is significantly associated with being underweight. The findings indicated the importance of maintaining a natural and functional dentition into old age, defined as having 20 or more teeth, for healthier nutrients intake and nutritional status.

In this study, findings from the logistic regression analysis revealed that the odds of having an unsatisfactory BMI were 3.6 times more in those with reduced number of POPs. The high odds may indicate that reduced number of posterior teeth that occlude is one of the early signs of being under-or overweight among older population. This can alert the older individuals as well as dental practitioners to seek and provide care in order to prevent the occurrence of unsatisfactory BMI among the vulnerable group (El Osta et al. 2014).

The emerging evidence on the role of posterior occluding pairs of teeth in nutritional status of older population has been documented in several studies (Iwasaki et al. 2016; Kikutani et al. 2013). The numbers of posterior teeth that occlude are more relevant for masticatory function compared to measures of number of teeth alone. Impaired in masticatory ability due to loss of occluding teeth may lead to lower intake of important nutrients among older individuals (Naka et al. 2014). Addition to that, reduced number of POPs also increased the risk of being under- or overweight among elderly (Wiener & Wiener 2015; De Andrade et al. 2011).

However, it is important to stress that BMI is not only determined by tooth loss but also influenced by several factors like medical problems, multiple intake of medications, dietary habits and socio-economic status, which later can affect the food selection of older adults (Aminde et al. 2017). Several studies that evaluate the association between tooth loss and nutrition also have not considered physical activity as the factors studied. Physical activity is known to be an important predictor of weight control and can be a confounding variable in the association (Cohen et al. 2016).

Although findings highlighted significant association between variables, some limitations of the study were observed. First, the design of the study was cross-sectional in nature, thus a causal relationship between the variables could not be established. Moreover, inverse causality like whether impaired nutrition might worsen the oral health conditions could not be excluded. Moreover, the assessment of nutritional status in this study was based only on anthropometric parameters like BMI. Therefore, it may not be able to measure the qualitative aspects of the elderly people, for example perception, presence of comorbidities and dietary pattern (Lopez-Jornet et al. 2013). Lastly, the number of underweight older adults in this study was very small for analysis purposes. The underweight respondents were grouped together with overweight and obese into unsatisfactory BMI category. Thus, the true association between underweight and nutritional status in this study sample could not be explored.

CONCLUSION

In conclusion, it is important for dental professionals to promote optimum number of posterior teeth that occlude among older adults as it is important for healthy natural functional dentition throughout life as well as to maintain a satisfactory BMI in this vulnerable group.

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